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BOOK REVIEWS.

DARWIN AND AFTER DARWIN. I. THE DARWINIAN THEORY. By *George John Romanes*, M. A., LL. D., F. R. S. London: Longmans, Green & Co. Chicago: The Open Court Publishing Co. 1892.

In the present work by Professor Romanes, who may be regarded as the special exponent of Darwin's theory of organic evolution, we have a complete and systematic presentation of "Darwinism according to Darwin." It is the outcome of a course of lectures delivered by the author in 1889 before the Royal Institution, London, and forms only part of a much more extensive treatise on the Darwinian theory, embracing the early history of biology, and a discussion of the further developments of the theory subsequent to the death of the great naturalist who gave it birth. The present part is limited to what is distinctly Darwinian, dealing with it and with the main objections raised against the general theory of organic evolution it enforces.

The subject naturally divides into two parts, and Professor Romanes accordingly deals with it in two sections, in the first of which he considers organic evolution as a fact, stating the main evidences in support of the doctrine, while in the second section he furnishes "the evidences which thus far have been brought to light touching the causes of organic evolution considered as a process." The author points out in his introductory remarks, that in order to establish a theory of a continuous transmutation of species, which is what is meant by organic evolution, it is not necessary to furnish proof of *all* the natural causes which have been at work The issue is between the theory of a supernatural cause, as operating immediately in numberless acts of special creation, and the theory of "natural causes as a whole whether these happen, or do not happen, to have been hitherto discovered." Moreover, the discussion is concerned only with the origin of species, and not with that of life, as to which the author says with truth, "although in the opinion of most biologists it is a question which we may well hope will some day fall within the range of science to answer, at present, it must be confessed, science is not in a position to furnish so much as any suggestion upon the subject; and therefore our wisdom as men of science is frankly to acknowledge that such is the case."

The idea of evolution implies continuity, and the author refers to the fact that the uniformity of nature's method in the production of phenomena to which continuity is due, recognised in other fields of science, strongly recommended the theory of organic evolution for acceptance on merely antecedent grounds. There is another important fact, from the antecedent point of view, to which Professor Romanes draws attention. He states it in the words of Mr. Wallace, who lays down as a general law that "every species has come into existence coincident both in space and time with a pre-existing and closely allied species." This is a necessary consequence of natural evolution, but no reason can be assigned for it on the theory of special creation, and the existence of such a correlation may be regarded as a test-question between the two theories.

The direct evidence in favor of organic evolution brought together in the first section of the present work is considered under the several heads of classification, Morphology, Embryology, Palæontology, and Geographical Distribution. As to the first of these subjects, the object of classification has been the arranging of organisms in accordance with their natural affinities. Organisms have been compared for the purpose of ascertaining which of the constituent organs are of the most invariable occurrence, and therefore of the most typical significance, and the author shows that "all the general principles and particular facts appertaining to the natural classification of plants and animals, are precisely what they ought to be according to the theory of genetic descent; while no one of them is such as might be—and indeed, used to be—expected upon the theory of special creation." In connection with the important subject of Morphology, the author, after showing that the theory of descent with continued adaptive modification fully explains all the known cases of divergence from the typical structure which an organism presents, devotes himself especially to the argument from rudimentary structures. These are of such general occurrence that they are found in every species, and such obsolescent or vestigial structures, as the author terms them, are of great value as evidence for the theory of evolution, particularly those found in adult man. To human vestigial structures the author pays particular attention, his observations being accompanied by excellent illustrations from nature. It is noteworthy that he abandons the flattening of the tibia in man, and the disposition of valves in human veins, as arguments in support of man's natural origin, which is abundantly supported, however, by reference to other rudimentary organs.

The science of Embryology is of special importance, on account of the history it affords of the *process* of evolution, and thus supplying evidence of the fact, although the author remarks, "the foreshortening of developmental history which takes place in the individual lifetime may be expected often to take place, not only in the way of condensation, but also in the way of excision." To understand the argument from embryology it is necessary to trace the first beginning of individual life in the ovum, and for this purpose to consider the phenomena of reproduction in their most simple form. In connection with this subject, Professor Romanes, after examining the features in which the cell-division of protozoa differs from that of metazoa, and after considering the grounds on which it may be concluded that there is a physiological continuity between growth and sexual reproduction, points out that the constructive argument in favor of evolution derived from embryology commences with the fertilisation of the metazoal ovum. As this first stage has not been adequately treated by any other writer, the author deals with it at considerable length. The later stages of individual development, including that of the vertebrata, on the lines of Haeckel's ideal primitive vertebrate, are more concisely treated. The science of embryology, covers the whole field of animal life, and it is not surprising therefore that it is considered by the author and other evolutionists as furnishing the strongest support to the theory of evolution.

As to the palæontological evidence, Professor Romanes does not ascribe to it the paramount importance which it has in popular judgment. Nevertheless he asserts that, not only is no positive proof against the theory of descent to be drawn from a study of palæontology, but it proves two very important general facts in favor of it. These are that from the earliest to the latest times there has been a constant and progressive increase in the diversity of types both of animals and plants, and that "through all these branching lines of ever-multiplying types, from the first appearance of each of them to their latest known conditions, there is overwhelming evidence of one great law of organic nature—the law of gradual advance from the general to the special, from the low to the high, from the simple to the complex." These general facts are supported by detailed consideration of fossil horns, bones, teeth and shells, which supply four special lines of evidence. The evolution of mammalian limbs with particular reference to the hoofed animals is treated with a fulness its importance requires.

As the geological argument is concerned with the distribution of species in time, so that based on the present geographical distribution of animal and plant species is concerned with their distribution in space. This, although not regarded by the author as a crucial test between the rival theories of creation and evolution, is declared to be one of the strongest lines of evidence in favor of the latter. The general facts relied on are, the discontinuity of distribution of certain species, the absence of any *constant* correlation between habitats and animals or plants suited to live upon them, and the presence in every biological region of species related to other species in genera, and usually also genera related to other genera in families; this correlation between a geographically restricted habitat and the affinities of its fauna and flora being repeated over and over again throughout the earth's surface. But further, the correlation between habitats and their animals and plants is not limited to the now existing species, that is, the dead and living species are allied, showing that the latter are modified descendants of the former. Moreover, where the areas of distribution are not restricted, through species wandering away from their native homes, the course of their wanderings is marked by the origination *en route* of new species. Another important consideration is that a double correlation exists in the geographical distribution of organic types. That between the geographical restriction and natural affinity among inhabitants of the same areas has already been mentioned. The second is the correlation between *degrees* of geographical restriction and *degrees* of natural affinity. This is consonant with the theory of descent with modification, as "the more distant the affinity, and therefore, *ex hypothesi*, the larger and the older the original group of organisms, the greater must be the chance of dispersal." These general considerations are supported by detailed illustrations drawn from the distribution of aquatic and terrestrial organisms. The author shows that an examination of the faunas and floras of oceanic islands establishes the general law "that *wherever* there is evidence of land-areas having been for a long time separated from other land-areas, there we meet with a more or less extraordinary profusion of unique species, often running up into unique genera." There is, moreover, a constant correlation between the *degree* of this peculiarity, and the time during which the fauna and flora have been isolated. The author concludes this part of his argument by the forcible observation that "if the doctrine of special creation is taken to be true, then it must be further taken that the one and only principle which has been consistently followed in the geographical disposition of species, is that of so depositing them as to make it everywhere appear that they were not thus deposited at all, but came into existence where they now occur by way of genetic descent with perpetual migration and correlative modification."

The second part of this work, that which treats of selection, under the two heads of Natural Selection and Sexual Selection, although in some respects the most important, does not need to be noticed so fully as that which deals with the facts of natural evolution. After stating the theory of natural selection, the author notices various fallacies connected with it which are largely prevalent among the adherents of Darwinianism, although nowhere fallen into by Darwin himself, and the still greater fallacies found in the writings of his opponents. In the two following chapters Professor Romanes, after stating the main arguments in favor of the theory of natural selection, reviews the main objections which have been urged against it. The first argument is that, as a matter of observation, "the struggle for existence in nature does lead to the extermination of forms less fitted for the struggle, and thus makes room for forms more fitted." The second argument, which the author considers of overwhelming significance, is that there is not a single instance, in either the vegetable or the animal kingdom, of a structure or an instinct which is developed for the exclusive benefit of another species. Its importance may be judged by the fact that Darwin considered that a single instance to the contrary would invalidate the whole theory of natural selection. The third argument is based on the facts connected with the variation of animals and plants under domestication. Ocular evidence of the value of this argument is furnished by a series of drawings prepared for the present work representing varieties of pigeons, and of eight other animals. As special illustrations of natural selection the author considers the subjects of protective colouring, warning colours, and mimicry. In referring to his treatment of the criticisms of the natural selection theory, in the course of which he deals with the main objections, we cannot do more than mention that based on the possession by the skate of an electric organ, which, owing to the weakness of its discharges, cannot apparently be of any use to the animal. This difficulty seems to be unexplainable according to the principles of natural selection, and Professor Romanes, in admitting the fact, remarks that it is of a magnitude and importance "altogether unequalled by that of any other single case—or any series of cases—which has hitherto been encountered by the theory."

The last chapter of the work is devoted to the consideration of the theory of Sexual Selection, which was suggested by Mr. Darwin to furnish a scientific explanation of the wide generality of beauty in organic structures. It is an observed fact that sexual selection does take place among the higher animals, and it is inferred that, the selection has reference to an æsthetic taste on the part of the animals themselves ; and that this cause is adequate to explain the phenomena of beauty presented by such animals. After stating the evidence in favor of these conclusions, the author considers at length Mr. Wallace's views on the subject. These constitute the objections urged against the theory of sexual selection, of the truth of which, however, Darwin shortly before his death expressed himself as remaining firmly convinced.

Professor Romanes concludes his present volume with a few general remarks on the philosophical relations of Darwinism to the facts of adaptation on the one hand and to those of beauty on the other. In none of these, says the author, do we meet with any independent evidence of supernatural design, although there is abundant evidence throughout organic nature of natural causation. And yet natural causation furnishes no disproof of the existence of a Supreme Being. The whole of organic and inorganic nature is made subject to one rule of government, but "the ulterior and ultimate question touching the nature of this government as mental or non-mental, personal or impersonal, remains exactly where it was." Moreover, if there be an intelligent First Cause, of whose Will all secondary causes are the expression, their operation must be uniform, so far as the Will is consistent, and therefore it must appear as what we call mechanical. Thus according to the pure logic of the matter, "the proof of organic evolution amounts to nothing more than the proof of a natural process."

In an appendix to Chapter V, Professor Romanes offers suggestions as to the imperfection of the geological record, and meets various objections against the theory of organic evolution on that ground. But we must now leave this excellent work, which will undoubtedly answer the expectation with which it was prepared, of being "a compendium, or hand-book, adapted to the requirements of a general reader or biological student, as distinguished from those of a professed naturalist."

It is enriched by a very good portrait of Darwin, in whose footsteps the author has sought to tread by "avoiding dogmatism on the one hand, and undue timidity as regards general reasoning on the other." In his introductory observations he dwells on the remarkable influence exercised by Darwin over the method of investigation of organic nature, by treating the discovery or accumulation of facts, not as an end, but as a means for generalisation, thus bringing natural history into a line with other inductive sciences.

The value of the work is materially increased by the addition of numerous well executed original illustrations, besides various plates derived from Haeckel's works and other sources, some of them American. It has also a good Index which will add much to its usefulness. Ω.

GRUNDRISS DER NATURLEHRE FÜR DIE OBEREN CLASSEN DER MITTELSCHULEN. Von Dr. *E. Mach*. Ausgabe für Gymnasien. Mit 358 Abbildungen. 315 pp Vienna and Prague: F. Tempsky. Leipsic: G. Freytag.

The principles that have guided Professor Mach in the preparation of these outlines of Physics, are in the main as follows:

The concepts and notions of physical science should not be set forth dogmatically, but should be presented as much as possible under the influence of the actual natural facts that lead to them. Hypotheses and theories should be employed only when actually necessary. Long mathematical developments and pages of formulae only impede the scholar's total view of his subject and afford of themselves no insight. *Logical* finish should not be sought after in elementary presentations; the method of the inculcation of truths should, so to speak, be *psychological*: the method of their acquisition.

From the brief statement of these guiding principles, the reader will observe that Professor Mach's conception of the proper form of an elementary text-book, differs greatly from that usually entertained. The method of presentation is not the dogmatic, the "logical," which sets forth a science as a ready-made and perfected, mystically created, product; but the genetic, the historical, the natural. We are constantly made aware, in the study of this book, of what knowledge really means and what it does not. We are not treated, in its introductory chapter, as we are in most of the text-books of Physics, to disquisitions on the insolubility of the questions What is Matter, What is Energy, What is Force, and to like professions of metaphysical ignorance, which make us wonder how people can request us to read hundreds of pages about things it is impossible to have knowledge of; but we are presented throughout with a simple statement and description, in terms of facts, of what our fundamental, as well as our derived, notions *are*, and what their import. It is unnecessary to say that the need of such a book is very great. And it is pleasant, constantly to discover how well its idea has been executed. Concise, unburdened by unnecessary and self-evident developments, it is in our judgment a model of elementary exposition.

With characteristic modesty, Professor Mach disclaims all pretension to having fully realised his conception, and views his performance simply as an attempt. The book was submitted, before publication, to a number of competent educators, whose advice in regard to alterations was frequently acted upon. μκρκ.